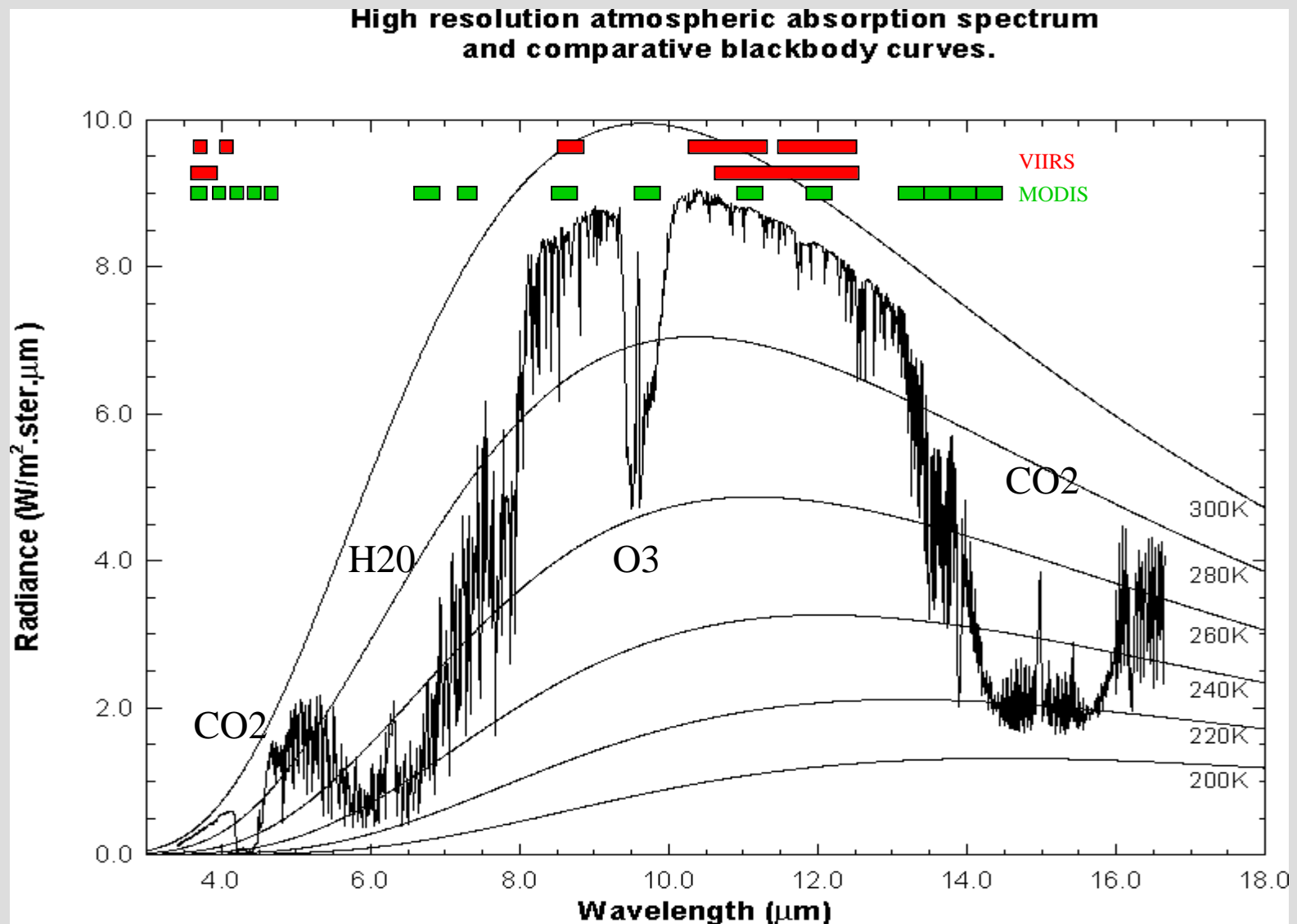# Changes in Total Precipitable Water Vapor – Infrared (MOD-05)

Suzanne Wetzel-Seemann, Jun Li, Liam Gumley, and Paul Menzel

22 Jul 2002

Earth emitted spectra overlaid on Planck function envelopes

High resolution atmospheric absorption spectrum and comparative blackbody curves.

Total Water Vapor Retrieval from MODIS IR Radiances

$$I = \varepsilon^{sfc} B(T(p_s)) \tau(p_s) - \int_o^{p_s} B(T(p))[d\tau(p)/dp]\,dp.$$

I1, I2, I3, ... , In are measured with MODIS
P(sfc) and T(sfc) come from ground based conventional observations
τ(p) are calculated with physics models

Regression relationship is inferred from (1) global set of in situ radiosonde
  reports, (2) calculation of expected radiances, and (3) statistical non-linear
  regression of observed Raob TPW and calculated MODIS radiances
  (brightness temperatures)

Need RT model, estimate of ε^{sfc}, and MODIS radiances

* Changed predictors band 24 and 25 (4.4 and 4.5 um) brightness temperatures to their BT difference to remove surface effects:

Old algorithm had 12 predictors:
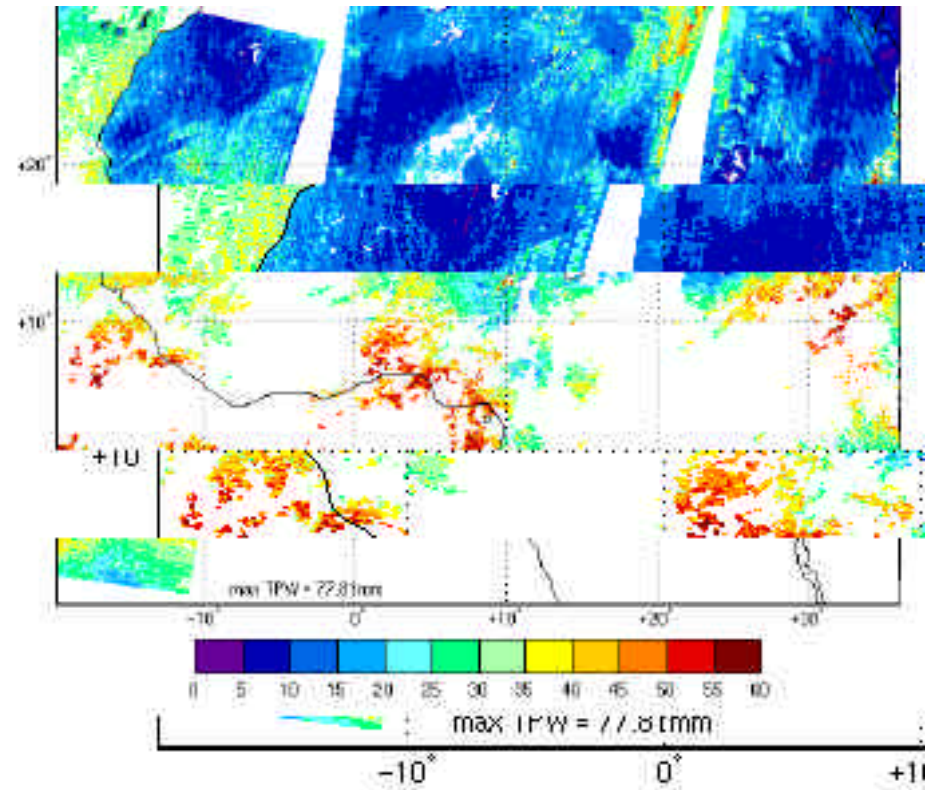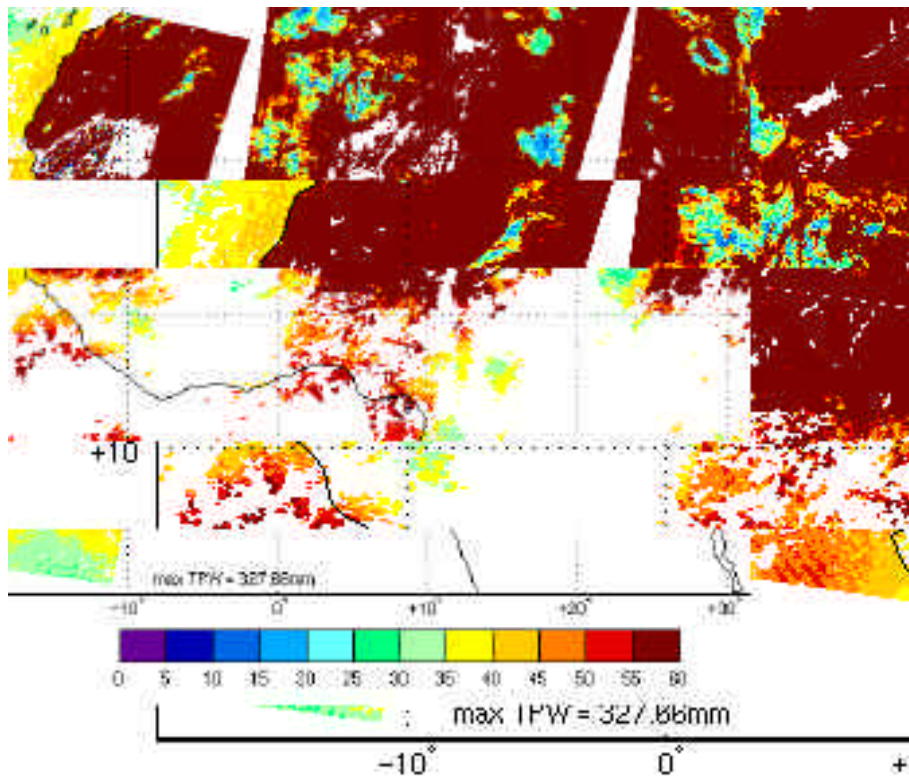
individual bands 24, 25, and 27 through 36.

New algorithm has 11 predictors:

band 25 - 24 BT difference and

individual bands 27 through 36.

* Separated training into seven regression BT zones to include a broader range of moisture regimes

* Implemented global radiance bias corrections.

* Applied post-launch NEdT in place of pre-launch.

Previous MOD07 v3.0 (left) and new MOD07 v3.1.0 (right)
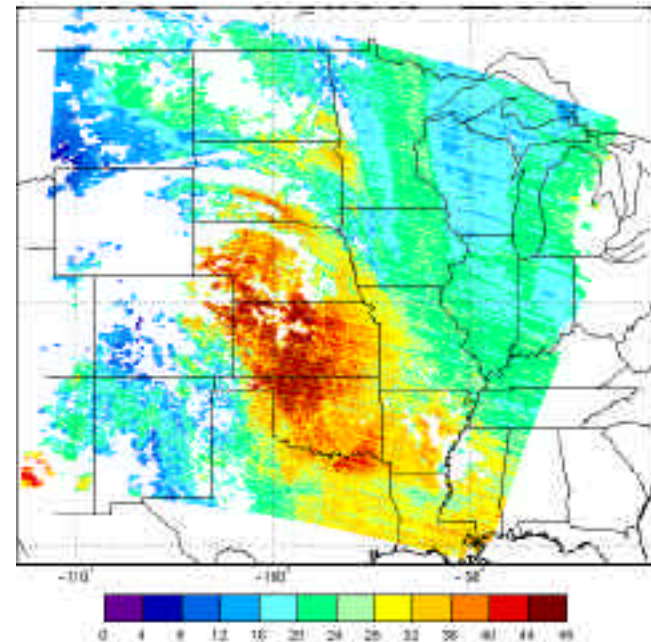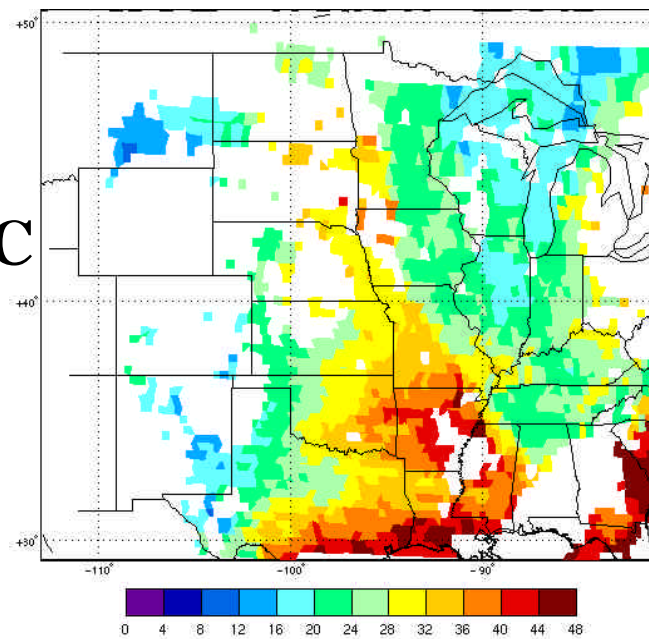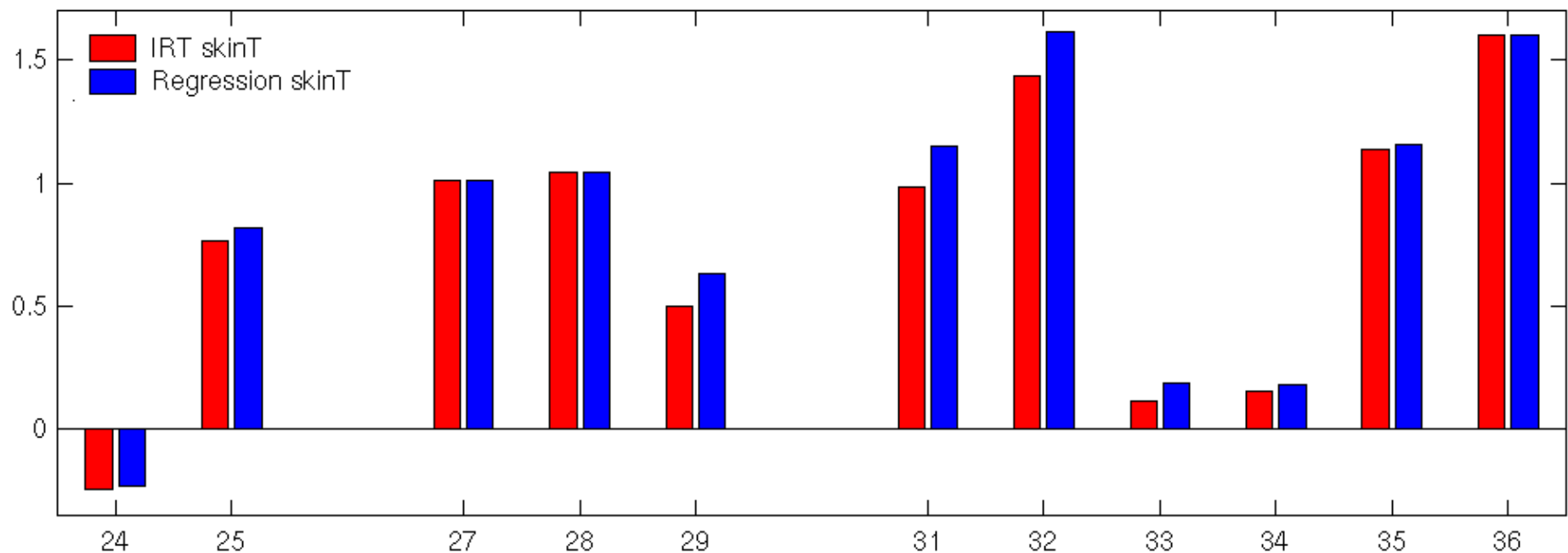for the north African deserts on June 2, 2001 at 0830-1155 UTC

MODIS new
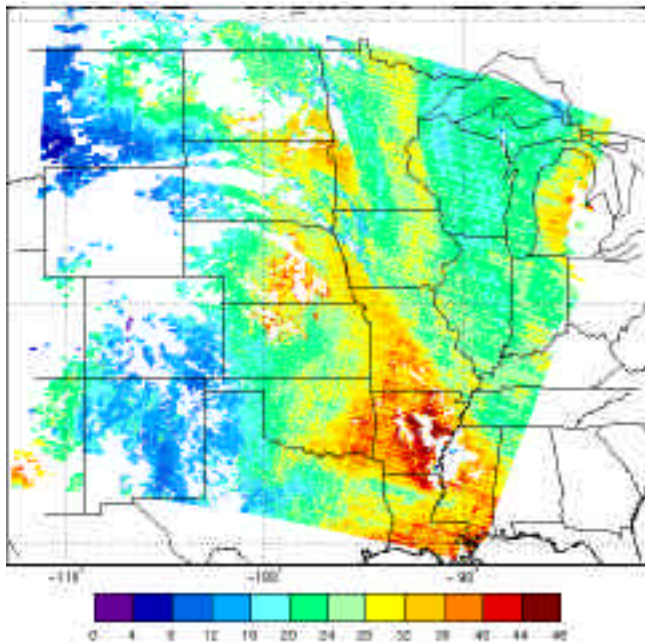
MODIS wo BT11 partitioning

**TPW
20 Aug 2001 18 UTC**

GOES -8

Average (Observed-Calculated) brightness temperature for MODIS IR bands 24, 25, 27-29, and 31-36 from 60 clear sky cases at the SGP ARM-CART site from April 2001 to June 2002. Red bars indicate radiance calculations used skin temperature observed by the IRT; regression-derived skin temperature was used for the calculated radiances in the blue bars. No bias is computed for band 30 because of insufficient ozone observations for input to the forward model

The global biases are separated into twelve groups:
six latitude zones:

> north tropical (latitude 0° to $+30^o$),
> south tropical (0° to -30°),
> north mid-latitude ($+30^o$ to $+50^o$),
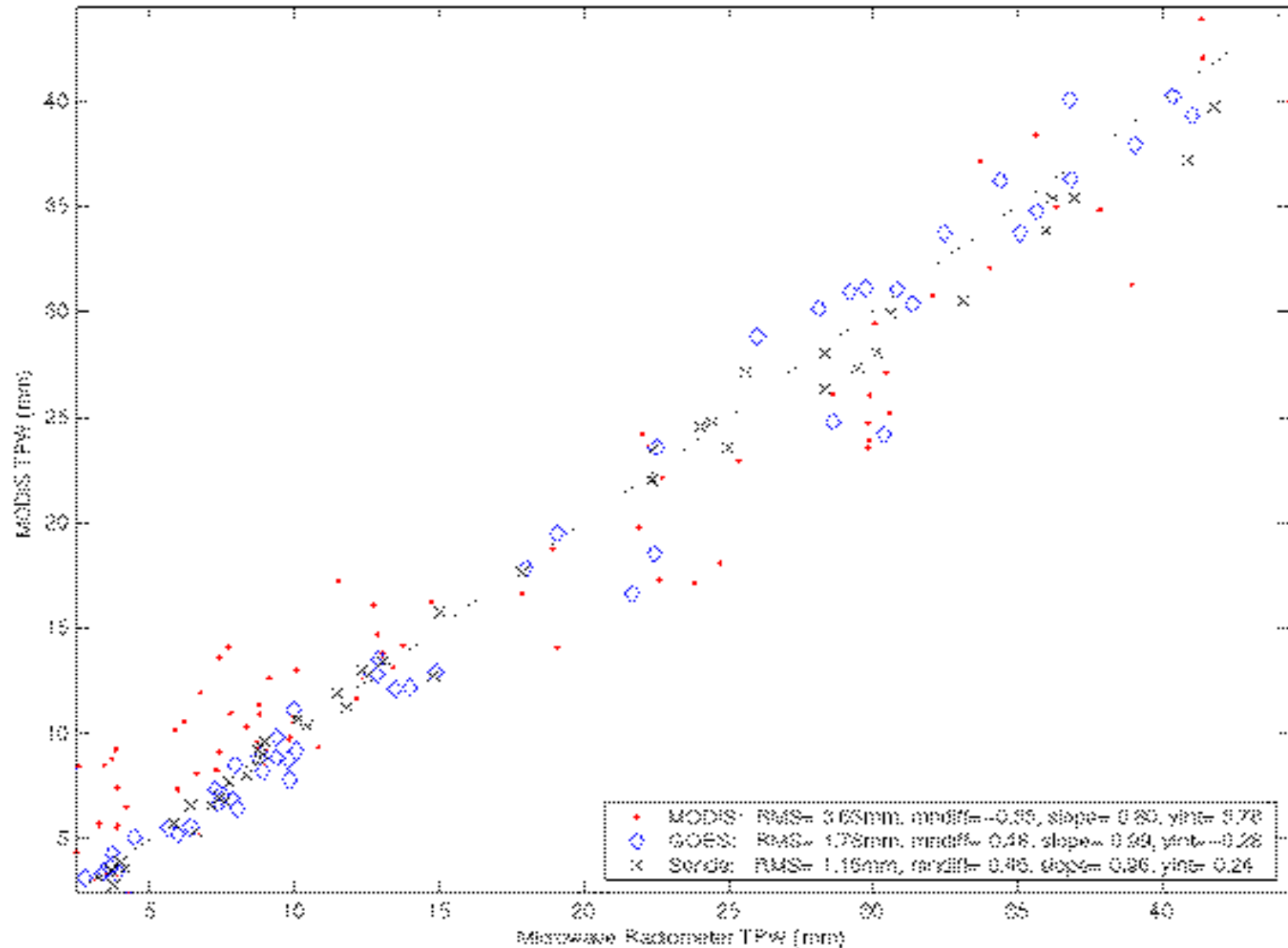> south mid-latitude (-30° to -50°),
> north polar (50° to 90°),
> south polar (-50° to -90°),

each for land and ocean.

The average global biases for north mid-latitude land agree fairly well with the CART site biases.

Bias values may vary seasonally so the bias corrections calculated from four days in June may need to be updated.

Comparison of TPW from MODIS regression (red dot), GOES-8 (blue diamonds), and radiosonde (black cross) with SGP ARM-CART microwave radiometer (MWR) in mm for 64 cases from April 2001 to June 2002
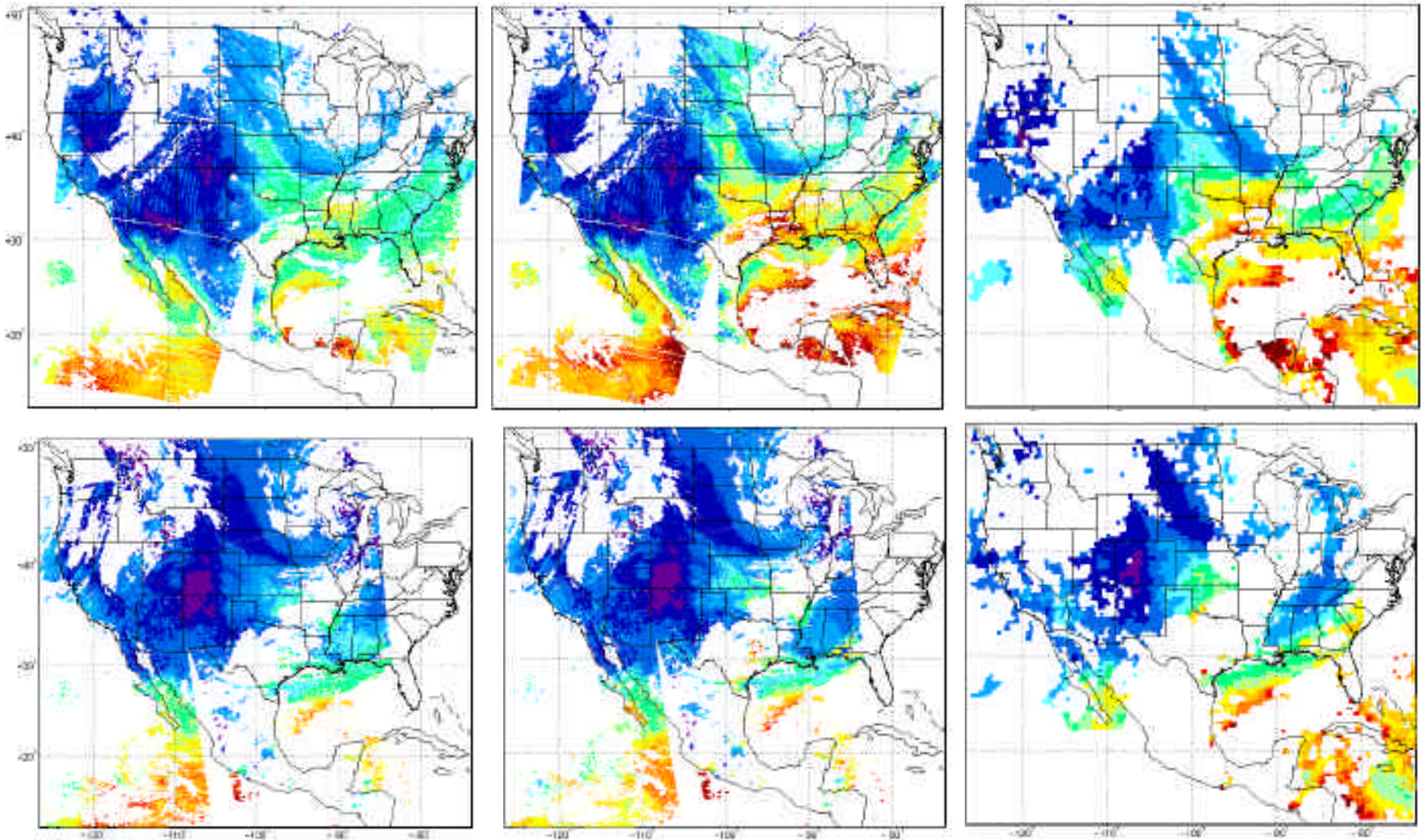
TPW (mm) for 02 June 2001 over North America retrieved by MODIS regression (left), MODIS physical (center), and GOES-8 and GOES-10 (combined, right). Day on top row and night on bottom row.
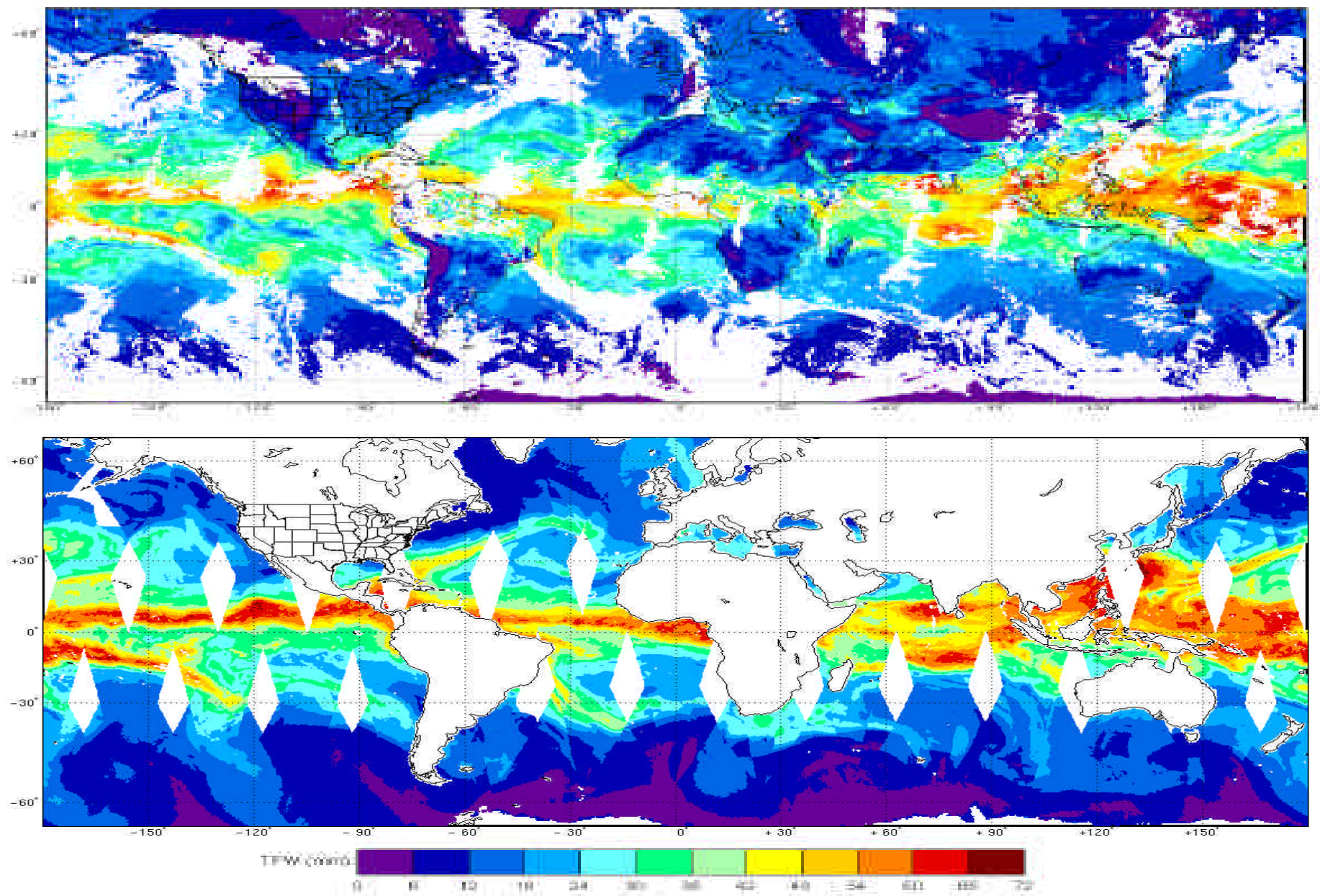
MODIS TPW (top) and SSM/I f-14 TPW (bottom) on 22 May 2002. Ascending and descending passes were averaged.
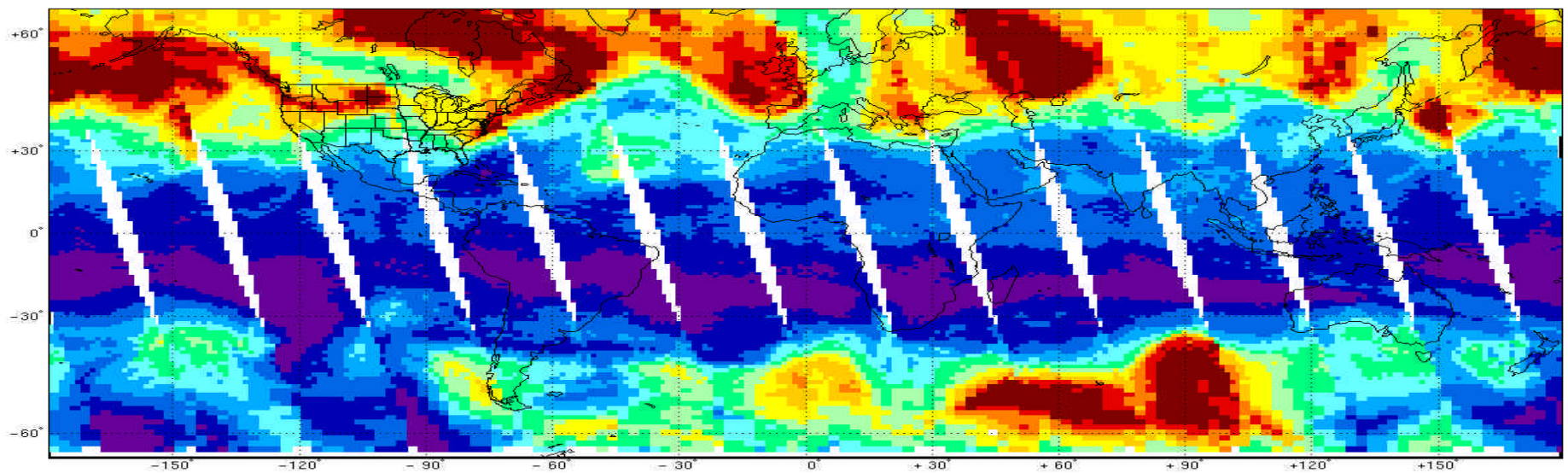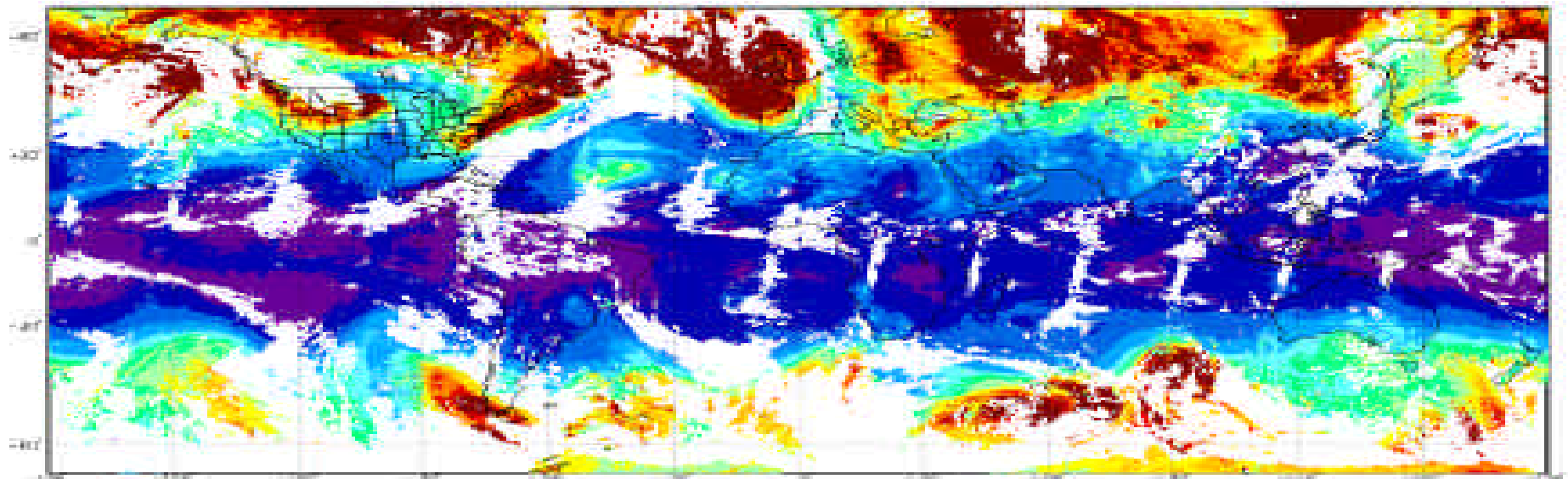
MODIS (top) and TOMS (bottom) total column O3 (Dobson units) for 02 June 2001

Ozone (dob):

240 255 270 285 300 315 330 345 360 375 390 405 420